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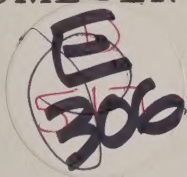
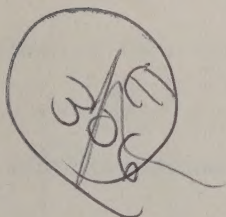
ECTIONS

STD. 31071

FEC

NO. 7552

POTENTIOMETER



LEEDS



NORTHROP

PHILADELPHIA 44, PA.

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Leeds & Northrup Company

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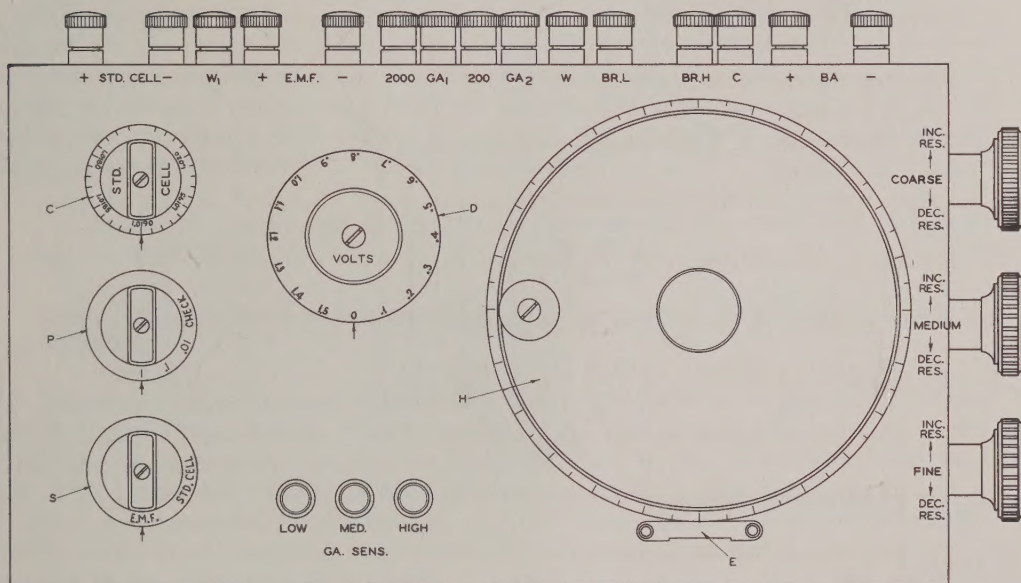


Fig. 1

1. GENERAL DATA

The No. 7552 Potentiometer is a precision instrument and should receive careful handling.

The potentiometer is equipped with binding posts BR.H and C, CHECK POSITION on selector switch, and plug receptacles at binding posts BR.H and BR.L, to facilitate the checking of the potentiometer and are not for use in making the usual measurements with the potentiometer.

Two flexible leads, each having a plug on one end, are furnished with each potentiometer. These leads are also for use in checking the potentiometer and are not for use in making the usual measurements with the potentiometer.

When a precision instrument, such as the No. 7552 Potentiometer, is used more or less continuously, it is advisable to have it checked at least once a year. It is recommended that this check be made by a testing laboratory or the manufacturer although the potentiometer may be checked by the user as directed in Sections 15 to 18 inclusive.

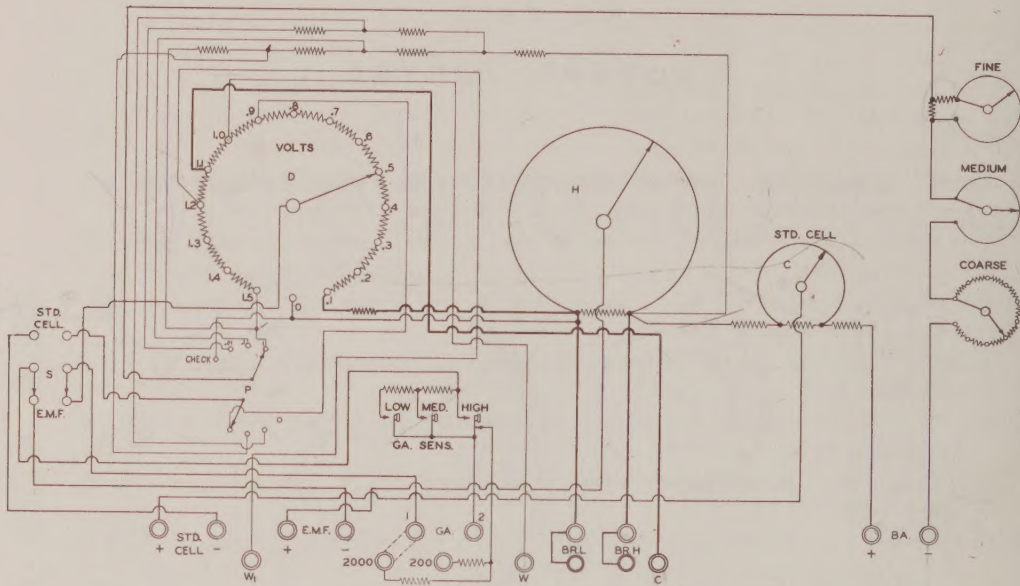


Fig. 2

2. WIRING CONNECTIONS

A. Internal

The internal wiring connections are shown schematically in Fig. 2. Similar designations in Figs. 1 and 2 refer to the same parts.

B. External To Measure EMF

It is recommended that a two volt storage cell be connected to the BA binding posts. However, two dry cells, connected in series, may be used for this service. If two dry cells are used, the current in the potentiometer circuit must be adjusted at frequent intervals since the current drain changes the voltage of the two dry cells rather rapidly. Connect a standard cell, such as L&N No. 7308, to the STD. CELL posts, and the source of electromotive force to be measured to the E.M.F. posts. In each case be sure that polarities, as indicated at the binding posts, are followed. Connect the galvanometer to the GA posts 1 and 2. Correct polarity for the galvanometer connections is important only when the galvanometer is to indicate by the direction it deflects whether the potentiometer setting is above or below the balance point. Clamp the metal link between post GA-1 and post 200 or 2000 depending upon whether a 200 ohm or a 2000 ohm damping resistance is better adapted to the galvanometer in use.

3. ADJUSTMENT OF CURRENT IN POTENTIOMETER CIRCUIT (Fig. 1)

Set the compensating dial C to correspond to the voltage of the standard

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cell as noted on the certificate or tag furnished with this cell.

The voltage of the standard cell may be certified in either international (U.S.) or absolute units. If the certificate or tag furnished does not indicate which system of units applies, consider the cell value as being given in international (U.S.) volts. When the standard cell dial is set to the voltage of the standard cell the instrument readings will be in terms of the unit system noted for the standard cell. If readings are desired in terms of the alternate unit system apply the conversion factor listed below to the certified cell voltage and set the standard cell dial to the calculated voltage value.

To convert from int (U.S.) volts to abs volts, multiply the int (U.S.) voltage by 1.000330.

To convert from abs volts to int (U.S.) volts, multiply the abs voltage by 0.999670.

Turn switch P to any position except CHECK and switch S to position STD. CELL. Turn knobs FINE, MEDIUM, and COARSE, on the right hand side of the instrument, as far as they will go in the direction marked INC. RES. Tap the key LOW with a sharp quick tap, and note in which direction the galvanometer deflects. Turn knob COARSE back toward DEC. RES. step by step, tapping key LOW after each step until the galvanometer deflects in the opposite direction. Then turn this knob back one step toward INC. RES. and turn knob MEDIUM until there is only a very small and slow galvanometer deflection when key LOW is tapped. Turn knob FINE and tap keys LOW, MED., and HIGH in succession until there is no galvanometer deflection whatever when key HIGH is tapped. The potentiometer current has now been adjusted in terms of the standard cell. Turn switch S to position E.M.F. and do not disturb settings of FINE, MEDIUM, and COARSE knobs until the potentiometer current must be adjusted again.

During a series of measurements it is advisable to check the potentiometer current occasionally and adjust it when necessary. The frequency with which such checks need be made depends upon the condition of the battery and the precision required in the measurements. Subsequent adjustments of the potentiometer current may at first be made only with knobs MEDIUM and FINE but in time as the battery voltage decreases, the knob COARSE must also be adjusted. Finally, when all three knobs have reached the end of their travel in the direction DEC. RES. and the galvanometer will not come to a balance, the battery must be renewed or recharged.

4. READING SWITCHES AND SLIDEWIRE (Fig. 1)

The reading of the potentiometer is obtained by adding the readings of dial switch D, glass scale E, and slidewire hood H. The sum of these readings is then multiplied by the reading of switch P. With switch P in

position 1, the range of the instrument is 0.00001 to 1.6 volts. Each of the fifteen steps on dial switch D corresponds to 0.1 volt. Each complete revolution of slidewire hood H, or each division on glass scale E, corresponds to a tenth of a step on dial switch D, or 0.01 volt. Fractional revolutions are read on the scale on hood H which may be read to thousandths of a revolution, or 0.00001 volt.

With switch P in position 0.1, the range is 0.000001 to 0.16 volt and with switch P in position 0.01, the range is 0.0000001 to 0.016 volt.

5. PRECAUTIONS FOR HIGH PRECISION MEASUREMENTS

When measurements of the highest precision are desired, be sure to adjust the zero position of the galvanometer immediately before each measurement is made. This may be accomplished by substituting a short copper jumper for the leads attached to the E.M.F. posts and then setting the galvanometer zero with the battery disconnected and with HIGH galvanometer key closed.

When the hood is rotated rapidly a thermal emf of the order of 5 to 6 microvolts may be generated as a result of friction between the slidewire and its contact. As the generated heat will be dissipated in a very short time, the emf will disappear before a precise balance can be made and, therefore, need cause no concern.

6. TO MEASURE EMF UP TO 1.6 VOLTS (Fig. 1)

Adjust the potentiometer current as directed in Section 3 and turn switch S to position E.M.F. Turn switch P to position 1.

If the nominal value of the electromotive force be known, set the dial switch D and slidewire hood E to correspond to this value as directed in Section 4. If, for example, the nominal value be 1 volt, set the dial switch D at 0.9 and the slidewire hood H at 10 on the glass scale E. This is of advantage, particularly in such work as standardizing instruments where the final setting is often within plus or minus 0.01 volt of the nominal value, as the final setting can be obtained with less than one turn of hood H, whether it be above or below the nominal value.

Tap keys LOW, MED., and HIGH in succession, and turn slidewire hood H until there is no galvanometer deflection. Use key HIGH for final adjustment.

If the nominal value of the emf be unknown, set dial D on zero and hood H at zero on glass scale E. Tap key LOW and note direction of the galvanometer deflection. Turn hood H clockwise as far as it will go, tapping key LOW occasionally to see if the galvanometer deflection reverses direction. If no balance point is indicated, set hood H at 10 on scale E and turn dial switch D from point to point, tapping key LOW for each set-

ting, until the galvanometer deflection reverses direction. Turn hood H counterclockwise until the galvanometer gives no deflection. Tap keys LOW, MED., and HIGH in succession during the balancing, and read switch D and slidewire H as directed in Section 4.

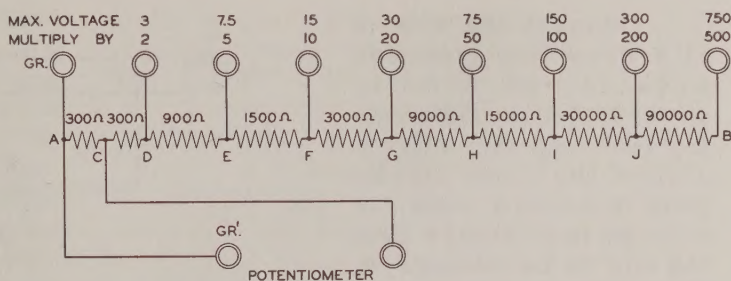


Fig. 3

7. TO MEASURE EMF UP TO 0.16 VOLT (Fig. 1)

Adjust potentiometer current as directed in Section 3. Turn switch S to position E.M.F. and switch P to position 0.1. Proceed as directed in Section 6 and multiply readings by 0.1.

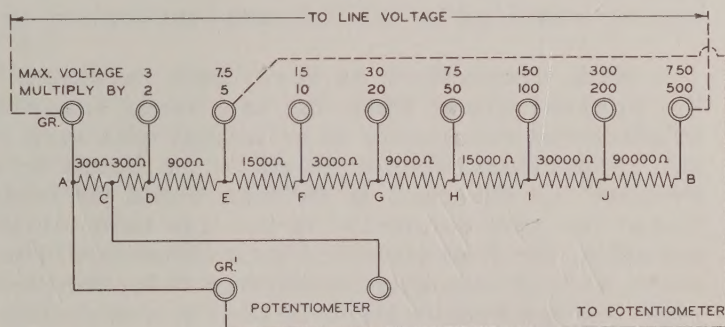


Fig. 4

8. TO MEASURE EMF UP TO 0.016 VOLT (Fig. 1)

Adjust potentiometer current as directed in Section 3. Turn switch S to position E.M.F. and switch P to position 0.01. Proceed as directed in Section 6 and multiply readings by 0.01.

9. TO MEASURE EMF ABOVE 1.6 VOLTS

For measurements of electromotive forces in excess of 1.6 volts, it is necessary to use a volt box as directed in Section 10.

10. TO USE A VOLT BOX (Figs. 3 and 4)

To measure electromotive forces in excess of 1.6 volts, it is necessary to connect the unknown emf across a high resistance and to measure with the potentiometer a definite fraction of the total unknown emf. Fig. 3 shows a diagram of a typical volt box. In this diagram AB is a high resistance of which AC is one five-hundredth, AD is one two-hundred-fiftieth, AE is one hundredth, AF is one fiftieth, etc., of the total resistance. The potentiometer reading is multiplied by 2, 5, 10, 20, 50, 100, 200 or 500, depending upon the posts to which the emf is connected.

119348
238696

Connect one side of the line (the grounded side if one side is grounded) to the GR binding post and the other side of the line to the post marked with the voltage next higher than the emf to be measured.

Connect the GR' post to the potentiometer E.M.F. post having the same polarity as the side of the line connected to post GR. Connect the other POTENTIOMETER post on the volt box to the other E.M.F. post on the potentiometer. Proceed as directed in Section 6 and multiply all potentiometer readings by the indicated multiplier on the volt box.

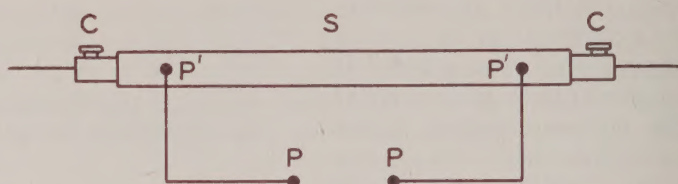


Fig. 5

With connections as described, maximum sensitivity is obtained and the current drawn from the line never exceeds 0.005 ampere. For work in which the sensitivity is sufficient with less current than 0.005 ampere, the connections should be made as noted by the broken lines in Fig. 4. Proceed as directed in Section 6 and the multiplying factor will then be that at the post connected to the line lead, divided by that at the post connected to the lead from the potentiometer. For example, to measure 110 volts without drawing more than 0.001 ampere from the line, connect as shown by the broken lines in Fig. 4, and multiply the potentiometer reading by the ratio of 500 to 5, or 100.

11. TO MEASURE CURRENT (Fig. 5)

Current measurements are made by measuring with the potentiometer the voltage drop across a known resistance as shown in Fig. 5. S is the standard resistor having current terminals CC and potential terminals P'P'. The potentiometer is connected to this shunt at posts PP. The resistance between points P'P' is adjusted to an even value. Most resistances for this purpose are so chosen, that to determine the current passing through the shunt, it is only necessary to multiply the potentiometer reading by a given factor. For example, in using a 0.01 ohm standard, it is necessary to multiply the potentiometer reading by 100, which gives the correct reading in amperes; in the same way a 0.1 ohm standard requires a multiplier of 10 and a 0.001 ohm standard, a multiplier of 1000.

12. TO TEST WATTMETERS ON DIRECT CURRENT (Fig. 6)

Make connections according to Fig. 6, using two double pole double throw switches external to the potentiometer as shown. Remove metal link from the GA post and connect the galvanometer as shown. Connect an external galvanometer damping resistance CDRX if necessary. Connect the positive side of the line to the GR binding post of the volt box and the other side of the line to the post marked with the voltage next higher than the line voltage. The line voltage should be such that when connected as noted,

Fig. 6

Throw knife switch 1 to position SH, and switch 2 to position A and make a current measurement as directed in Section 11. Again throw knife switch 1 to position V.B. and switch 2 to position B and check the voltage. If connection has been made to the W post, then the power in watts will be the product of the shunt current in amperes and the volt box multiplier. If connection has been made to the W1 post, then the power in watts will be the product of the shunt current in amperes, the volt box multiplier, and 1.2 volts, the drop across posts BR.L and W1.

13. CARE OF THE POTENTIOMETER

While the hood H is off and the contact is rotated to the top limit of

the slidewire, examine the threaded shaft, to which the contact arm is fastened. Clean this shaft, if necessary, and apply a small amount of vaseline for lubrication. To inspect the lower end of this shaft, rotate the arm, to which the contact is fastened, until the contact is at the bottom limit of the slidewire. Then turn the instrument

upside down and remove the screws, which hold the base to the top plate, and lift the base off. The lower end of the threaded shaft is now exposed, and can be cleaned and lubricated with vaseline. Replace the top plate on the base and fasten it in place with the screws. Then proceed as directed in the next paragraph.

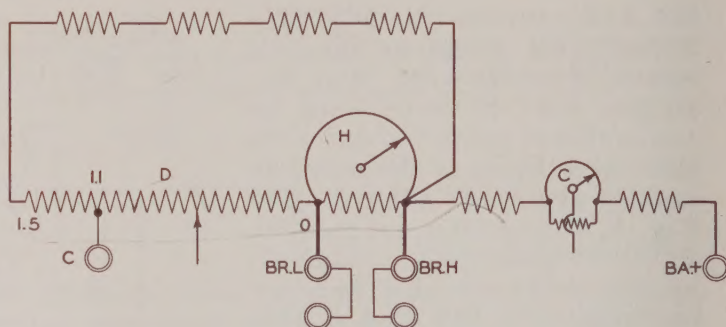


Fig. 7

Examine the glass-hard steel slider which makes contact with the slidewire. This should be highly polished and show no traces of wear, roughness or rust. If the contact needs cleaning, turn the contact arm until the contact rests on the last turn of the slidewire at the top of the drum. Carefully lift the contact just enough to clear the slidewire and slip a piece of paper under it and over the slidewire. Bend the paper around the surface of the drum and turn the contact arm back and forth three or four times so the contact rubs over the paper. Never use abrasive to clean this contact and never allow it to snap down on the slidewire when removing the paper. Do not remove the contact or spring from the arm as failure to replace either in the exact original position will destroy the calibration of the instrument.

When not in use, the hood should be turned all the way down and the lid put in place to exclude dust. In an atmosphere containing acid fumes, this is very important.

Keep the contact surfaces of the studs of dial switch D clean and bright at all times. To clean these studs remove the switch head by removing the screw in the knob. Lift the head off and wipe the studs carefully with a clean soft cloth dipped in vaseline.

14. WARNING

It is highly important never to draw current from the standard cell. To do so changes the emf of this cell which affects the accuracy of the potentiometer readings. If the standard cell be used only for adjusting the current as noted in Section 3, it will maintain its emf over a period of many years.

The standard cell should never be exposed to temperatures below 32 F or above 140 F.

15. TO CHECK COILS OF DIAL SWITCH D

Disconnect leads from posts BA, GA, STD. CELL, and E.M.F. Remove the screw from the top of dial switch D and lift off the moulded knob. Two flexible

leads, each having a plug on one end, are furnished with the potentiometer. Thoroughly clean these plugs and the plug receptacles in the studs of dial switch D. Plug the two leads into adjacent studs (do not use the zero stud) on dial switch D. Press the plugs in tightly and at the same time give them a quarter turn. Then, with a Wheatstone bridge, measure the resistance of each coil. In order to measure the first coil (between stud .1 and the end of the main slidewire H) one plug must be inserted in the receptacle above post BR.L. Add 0.0015 ohm to the measured value of the first coil, and 0.0005 ohm to the measured value of the second coil to allow for inequalities in internal lead resistance which do not affect the accuracy of potential measurements. After making the corrections, all coils should be within the average value of the coils within plus or minus 0.01 of one percent. In checking to such accuracy, reliable results are not possible unless precautions be taken which are commensurate with the precision necessary.

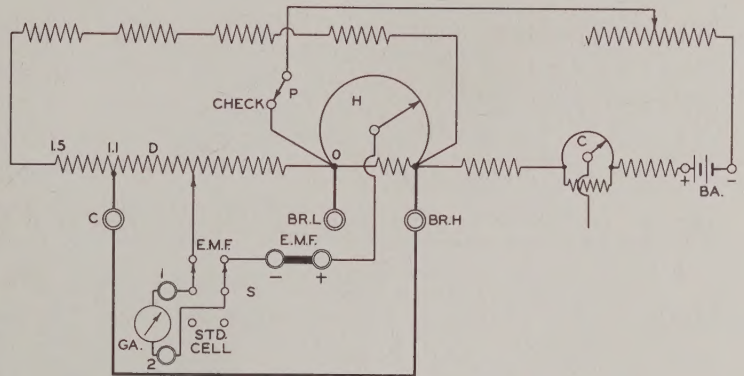


Fig. 8

16. TO CHECK SLIDEWIRE H (Fig. 7)

Disconnect leads from posts BA, GA, STD. CELL, and E.M.F. Connection to the ends of the slidewire is made by plugging the two leads, furnished with the potentiometer, into the receptacles above posts BR.L and BR.H. Measure the slidewire resistance with a Wheatstone bridge. Add 0.0015 ohm to the measured value to allow for inequalities in internal lead resistance which do not affect the accuracy of potential measurements. This corrected resistance should be 1.09873 times the average resistance of all coils in dial switch D (as measured and corrected in Section 15) within plus or minus 0.01 of one percent. In checking to such accuracy, reliable results are not possible unless precautions be taken which are commensurate with the precision necessary.

17. TO CHECK SLIDEWIRE C (Fig. 7)

Disconnect leads from posts BA, GA, STD. CELL, and E.M.F. Con-

nect leads to posts BR.H and BA+ and measure the resistance between these posts with a Wheatstone bridge. This resistance should be equal to the resistance of any coil in dial switch D (as measured in Section 15) within plus or minus 0.01 of one percent. In checking to such accuracy, reliable results are not possible unless precautions are taken commensurate with the precision necessary.

18. TO CHECK UNIFORMITY OF SLIDEWIRE H (Fig. 8)

Make connections to battery and galvanometer as directed in Section 2. Short-circuit the E.M.F. binding posts and connect posts BR.H and C with a short length of copper wire. Turn switch P to the CHECK position and switch S to the E.M.F. position. No connection need be made to the STD. CELL posts or to post BR.L. Turn the slidewire hood H to zero on the vertical glass scale E and to zero on the hood scale. Set dial switch D at the zero position. Turn hood H to 1 on the vertical glass scale E (this is one complete revolution of hood H). Turn dial switch D to point .1. With hood H and dial switch D set in this manner the galvanometer should show no deflection, (use key HIGH for the final balance of the galvanometer as directed in Section 6). Then turn hood H to 2 on the glass scale E and turn dial switch D to .2. The galvanometer should again show no deflection. Check each turn of slidewire H with the corresponding point on dial switch D as outlined above. The last point to be used on dial switch D will be 1.1.

If for any setting, as noted above, the galvanometer does not balance at zero, move hood H until a balance is obtained. The scale reading on hood H will give the error involved for this setting. This error should be within a half of the smallest scale division on hood H.

